REMARKS

Addressing the Applicant's election after Examiner Restriction

[1] Applicant elected claims 1 and 32-94 as being related to the embodiment illustrated primarily in Figure 12, but inclusive of Fig 11 and corresponding to elements discussed in the detailed description and relating to the entire set of drawings. Applicant expressly reserved right of traversal, as the embodiments are all the same invention, embodied in apparatus and method, taken together as a system. Applicant believes this communication was made telephonically to the Examiner prior to the written election with traversal.

DRAWINGS

[2] Examiner objected to drawings as omitting elements referred to in the specification. Although the drawings, taken together as depicting the invention, do include the structural details for understanding the invention, Applicant includes herewith informal revisions to the drawings as originally submitted, attached hereto as Appendix C. Applicant respectfully submits that the Examiner's objections are completely addressed. Applicant will submit formal drawings corresponding to the informal set included herewith.

Addressing Claim Rejections – 35 USC section 112

[3] The Examiner rejected claims 1 and 32-94 under 35 USC 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant addresses each of the Examiners remarks in the order in which they appear in the Office Action.

Introductory remarks

[4] The distinct subject matter of the invention can be clarified for Claims 1, 32-94 by adding "additional" to claims 1 and 47; the Examiner must understand that this invention generates <u>additional wavelengths over and above the pump wavelengths, and such additional wavelengths are simultaneously available</u>. Generating additional wavelengths that are simultaneously available is a bandwidth increasing technique and is further explained in text on page 6 lines 26-31 of the replacement specification filed herewith. It should be noted that all of the wavelengths in the multiplicity of wavelengths are always simultaneously available in this invention. By contrast, the invention of Sanders only permits or outputs one output wavelength at any one time. In Sanders, the single output wavelength may be tuned to different values at different times, by tuning an input wavelength, *but at any time there is only one wavelength output.*

[5] With respect to the objection to claim 1 as being unclear concerning the reflective elements, the "reflective elements" can be a reflective Bragg grating or a reflecting facet, depending on the embodiment. This is clear upon a reading the entire specification and the discussion of each of the embodiments of the invention.

[6] With respect to the objection that the seeding is unclear in claim 1, line 11, it should be understood by reading the specification that seeding can occur in different embodiments by (a) the seeding lasers 1006 and 1007 (Fig 10) (b) the reflective element 112, (Fig 1) or (c) the seeding elements 1206, 1207, 1208 (Fig 12).

[7] With respect to the objection that in claim 1, line 12 it is unclear which element produces the discrete wavelengths, Applicant responds that "the discrete wavelengths" are produced because a resonant cavity can only support radiation discrete wavelengths that are related to the optical path length of the resonant cavity. And the mixing process produces more discrete wavelengths. This is a characteristic of resonant cavities that is well known to one skilled in the art. For further discussion please refer to page 7 lines 5-8 of the replacement specification filed herewith.

[8] Responding to the Examiner's objection to claim 32 and what reflective elements refers to therein, Applicant points out that in claim 32, the co-located cavities share the same reflective elements 1204 and 1205 and also seeding elements 1206, 1207, 1208 which may be other reflective elements.

[9] In claim 36 and 37 line 2, "the generated set" refers to the set of desired wavelengths the generation of which is the object of the invention. (original specification page 10 line 21) . This has been further clarified in the detailed description in the specification by adding –"referred to as the generated set of wavelengths because all of

the wavelengths in the set are simultaneously available-)" on page 10 line 31 to page 11 line 2.

[10] In claim 38, line 2, the antecedent basis for the "non-linear medium" is clarified on page 6 line 24. It should be noted that the description uses non-linear element and non-linear medium indiscriminately to communicate the non-linear dispersion shifted medium, or, more generally, optical processing medium. These are interchangeable terms to one of skill in the relevant art.

[11] Applicant regrets a typographical error in claim 41 caused confusion. The preposition "of" was omitted. In claim 41, " the seed wavelengths generate additional wavelengths of the multiplicity discrete wavelengths" should read " the seed wavelengths generate additional wavelengths of the multiplicity <u>of</u> discrete wavelengths" which is corrected in claim 41 and is explained in the original specification on page 6 lines 23 to page 7 line 5.

[12] Applicant regrets a typographical error in claim 47 .In claim 47 lines 4-6, " said optical processing element optically coupled to the optical processing element operable in a multiple pass resonant manner" should read " said optical processing element operable in a multiple pass resonant manner" and has been corrected in claim 47

[13] In claim 47 line 12, "the optical processing element operable in a multiple pass resonant manner" is explained on page 9 lines 25-30 in the original specification. Additional explanatory text has been added. See the replacement specification at page 10 lines 3-6.

[14] In claim, 47 lines 8-9, seeding elements can be different in different embodiments and be (a) the seeding lasers 1006 and 1007, (b) the reflective element 112, or (c) the seeding elements 1206, 1207, 1208

[15] In claim 47, line 8, " seeding elements operable in the optically processing element" operate by reflecting or transmitting specific wavelengths which explanatory text has been added to page 12, line 21-23 in the replacement specification.

[16] In claim 47, lines 11 and 12 were unintentional and have been deleted as the Examiner suggested.

In claim 55, line 1-2, "other reflective elements" were explained in the original specification at page 6 line 19 and on page 9 line 11; and further are now described in the replacement specification on page 12 line 21-23.

[17] In claim 58 line 2 "the set of wavelengths" is now described on page 10 line 31 to page 11 line 2. Please see also the responsive discussion of the objection to claim36 and 37 hereinabove.

[18] In claim 58 line 2 "the desired frequency separation of the set of wavelengths" is now described on page 11 line 2 of the replacement specification., and appeared in the original specification interspersed amongst in the text between page 9 line 8 though page 10 line 4.

[19] With regard to claim 60, the signal, discussed in the original specification at page 10 lines 7-16 has been defined on page 12 line 28 in the replacement specification.

[20] With regard to claim 61, feedback circuitry, a control mechanism and a stable reference has been added to figure 12 and described on page 12 line 27-31 in the replacement specification; moreover, this was discussed in the original specification at page 10 lines 7-16.

[21] In claims 82 and 83, line 2, "the generated set" is described in the replacement specification on page 10 line 31 to page 11 line 2. See the discussion responsive to Examiner's objections to claims 36 and 37 hereinabove, incorporated by reference, showing the antecedent base in the original specification.

[22] Claim 88, is canceled.

[23] In claim 94, lines 11 and 12, "means for seeding" can be different in different embodiments and can be (a) the seeding lasers 1006 and 1007, (b) the reflective element 112, or (c) the seeding elements 1206, 1207, 1208.

Addressing Claim Rejections – 35 USC section 102

[24] Examiner has rejected claims 1, 32-57 and 60-94 under 35 USC 102(b) as being anticipated by Sanders (5,912,910). Examiner has not objected to claims 58 or 59, and has indicated claim 59 to be allowable subject to overcoming 35 USC 112 objections and intervening limitations.

[25] Applicant respectfully points out that Sanders does not teach the simultaneous generation of a set of wavelengths. Sanders merely teaches output of a single, tunable wavelength. Applicant teaches the output of <u>a set of wavelengths – more than a single output at the same time</u>, and thus Sanders does not anticipate Applicant's invention.

[26] Addressing the Examiner's comments in order:

With regard to claims 1, 36-39, 41-57, 60-78, 82-86, 88-94, Sanders et al dose not teach generating a multiplicity or set of wavelengths that are simultaneously available. Sanders teaches generating a single wavelength which can be tuned to different values at different times. This is supported in Sanders as follows:

column 6 line 32 "to produce <u>a</u> third wavelength..."

column 6 line 38 "to produce wavelength λ_3 in the mid-IR ...."

column 7 line 18 "to produce <u>a</u> longer wavelength having <u>a</u> mid-IR ......"

column 8 line 65 "to produce <u>a</u> tunable mid-IR wavelength..."

[27] With regard to claim 32 the non-linear resonant cavity is defined by 36A and 36B which are high reflector elements (HR). The laser source 33 is external to the resonant cavity defined by 36A and 36B.

[28] With regard to claims 33 and 79, 34 and 80, 35 and 81, 40 and 87, again Sanders teaches only generating a single wavelength, not a set of wavelengths.

Sanders cannot anticipate Applicant because nothing depicted or taught in Sanders enables one of skill in the art to generate a set of simultaneous wavelengths as output from a resonant cavity.

[29] Applicant has amended the drawings, specification and claims to address the Examiner's objections, to correct typographical errors, and to put the applicant's submission in condition for allowance. Applicant respectfully requests Examiner allow claims 1 and claims 32-94 (excluding claim 88, which Applicant has cancelled). Applicant further requests the Examiner concede Applicant has properly reserved the right to traverse the restriction requirement as to the other embodiments of the invention, in claims 2-31.

[30] If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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Date: December 19, 2003

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Date: December 19, 2003

Signed: Josh Hogan

APPENDIX

CLAIM VERSION MARKED WITH CHANGES MADE TO CLAIMS 1, 41, 47

Claim 88 cancelled; all other claims as originally filed.

What is claimed is:

1. (Currently amended) A method of generating repetitive pulsed radiation with a multiplicity of <u>additional</u> discrete wavelengths,
   the method comprising:
   positioning an optical processing medium in a resonant cavity with reflective elements;
   and
   generating repetitive pulsed radiation from a pulsed laser source in a pump cavity with reflective elements;
   and
   coupling the resonant and pump cavities;
   and
   seeding the optical processing medium with at least some of the discrete wavelengths, such that pulsed radiation with a multiplicity of <u>additional</u> discrete wavelengths is generated.

2. The method of claim 1, wherein the optical processing medium has zero dispersion centered on the desired multiplicity of wavelengths.

3. The method of claim 1, wherein the optical processing medium is highly non-linear medium.

4. The method of claim 1, wherein the optical processing medium is dispersion shifted medium.

5. The method of claim 1, wherein the optical processing medium is dispersion shifted fiber.

6. The method of claim 1, wherein the optical processing medium is photonic crystal.

7. The method of claim 1, wherein the optical processing medium is photonic crystal fiber.

8. The method of claim 1, wherein the optical processing medium has reflective elements at both ends to comprise the resonant cavity.

9. The method of claim 1, wherein the optical processing medium has other reflective elements which reflect a portion of at least some of the multiplicity of discrete wavelengths.

10. The method of claim 9, wherein the wavelength values that these reflective elements reflect correspond to at least some wavelengths on a standard grid.

11. The method of claim 10, wherein the standard grid is an optical communications ITU grid.

12. The method of claim 1, wherein the repetition rate of the pulsed laser source is harmonically related to the desired frequency separation of the set of wavelengths to be generated.

13. The method of claim 1, wherein the pump cavity is a resonant cavity with a round trip time harmonically related to the repetition rate of the optical pulses from the pulsed laser source.

14. The method of claim 1, wherein the signal determining the repetition rate of the pulsed laser source is derived from the optical pulse output from at least one of the

cavities.

15. The method of claim 1, wherein the repetition rate of the pulsed laser source is maintained at fixed value by means of feedback circuitry, a control mechanism and a stable reference.

16. The method of claim 15, wherein the control mechanism is temperature control.

17. The method of claim 1, wherein the pulsed laser source is a pulsed laser diode.

18. The method of claim 1, wherein the pulsed laser source is a gain switched laser diode.

19. The method of claim 18, wherein the gain switched laser diode receives a current pulse from circuitry containing a step recovery diode and an RF source.

20. The method of claim 1, wherein the pulsed laser source is a mode locked laser source

21. The method of claim 1, wherein the peak power of the pulsed output of the pulsed laser source is increased by compressing the temporal duration of the pulses.

22. The method of claim 21, wherein the temporal compression of the pulses is achieved by means of saturable absorption.

23. The method of claim 21, wherein the temporal compression of the pulses is achieved by means of diffraction gratings.

24. The method of claim 21, wherein the temporal compression is achieved by means of distributed fiber diffraction grating.

25. The method of claim 21, wherein the temporal compression is achieved by means of at least one non linear fiber loop.

26. The method of claim 1, wherein the pulsed laser source is stabilized to emit radiation at a specific wavelength.

27. The method of claim 26, wherein the pulsed laser source is wavelength stabilized by means of seeding by a wavelength stabilized laser.

28. The method of claim 13, wherein the pulsed laser source in a resonant pump cavity is wavelength stabilized by means of a reflective Bragg grating in the resonant cavity.

29. The method of claim 1, wherein the pump cavity is coupled to the resonant cavity by means of fiber coupling.

30. The method of claim 1, wherein the pump cavity is coupled to the resonant cavity by means of waveguide elements.

31. The method of claim 1, wherein the resonant cavity and the pump cavity are coupled interferometrically to transfer substantially all the pump radiation to the resonant cavity and to prevent radiation at the pump wavelength from emerging from the resonant cavity at the coupler.

32. The method of claim 1, wherein the resonant cavity and the pump cavities are coupled by being co-located as a single resonant cavity, which is comprised of the laser source, the optical processing medium and reflective elements.

33. The method of claim 1, wherein at least one reflective element is a facet of a laser source.

34. The method of claim 1, wherein at least one reflective element is an end of the optical processing medium.

35. The method of claim 1, wherein the reflective elements are distributed Bragg gratings.

36. The method of claim 1, wherein one reflective element is designed so that it is highly reflective at the wavelengths of the generated set and at the wavelength of the laser source.

37. The method of claim 1, wherein at least one of the reflective elements transmits an equal amount of each wavelength in the generated set of wavelengths.

38. The method of claim 1, in which the pump radiation coupled into the resonant cavity generates other wavelengths by means of wave mixing in the non-linear medium.

39. The method of claim 1, wherein at least some of the reflective elements of the resonant cavity reflect a portion of at least some of the multiplicity of discrete wavelengths in a manner that is synchronous with the pump to seed the generation of these reflected wavelengths.

40. The method of claim 1, wherein two low power continuous wave laser diode sources are also coupled into the resonant cavity to seed generation of higher power pulsed radiation at the wavelengths of the two low power laser diodes, said higher powered pulsed radiation being powered by the pump radiation.

41. (Currently amended) The method of claim 1, wherein the seed wavelengths generate additional wavelengths of the multiplicity of discrete wavelengths.

42. The method of claim 1, wherein the multiplicity of wavelengths generated correspond to wavelengths on a standard grid.

43. The method of claim 42 wherein the standard grid is an optical communications ITU grid.

44. The method of claim 1, wherein the cavities include waveguide elements.

45. The method of claim1, wherein at least the resonant cavity is a waveguide resonant cavity.

46. The method of claim 1, wherein the resonant cavity has a fiber coupled output.

47. (Currently amended) An apparatus for generating repetitive pulsed radiation with a multiplicity of <u>additional</u> discrete wavelengths,

the apparatus consisting of:

an optical processing element with reflective elements, <u>said optical processing element operable in a multiple pass resonant manner;</u>

and

seeding elements operable in the optically processing element to initiate generation of at least some of the discrete wavelengths;

and

an optically active element with reflective elements operable to generate repetitive pulsed pump radiation, said optically active element optically coupled to the optical processing element,

and

operable to transmit such repetitive pulsed pump radiation to the optical processing element, such that repetitive pulsed radiation with a multiplicity of <u>additional</u> discrete wavelengths is generated.

48. The apparatus of claim 47, wherein the optical processing medium has zero dispersion centered on the desired multiplicity of wavelengths.

49. The apparatus of claim 47, wherein the optical processing medium is highly non-linear medium.

50. The apparatus of claim 47, wherein the optical processing medium is dispersion shifted medium.

51. The apparatus of claim 47, wherein the optical processing medium is dispersion shifted fiber.

52. The apparatus of claim 47, wherein the optical processing medium is photonic crystal.

53. The apparatus of claim 47, wherein the optical processing medium is photonic crystal fiber.

54. The apparatus of claim 47, wherein the optical processing medium has reflective elements at both ends enabling said optical processing medium to operate in a multiple pass resonant manner.

55. The apparatus of claim 47, wherein the optical processing medium has other reflective elements operable to reflect a portion of at least some of the multiplicity of discrete wavelengths.

56. The apparatus of claim 55, wherein the wavelength values that these reflective elements reflect correspond to at least some wavelengths on a standard grid.

57. The apparatus of claim 56, wherein the standard grid is an optical communications ITU grid.

58. The apparatus of claim 47, wherein the repetition rate of the repetitive pulsed pump radiation is harmonically related to the desired frequency separation of the set of wavelengths to be generated.

59. The apparatus of claim 47, wherein the optically active element is operable in a resonant manner with a round trip time harmonically related to the repetition rate of the repetitive pulsed pump radiation from the optically active element.

60. The apparatus of claim 47, wherein the signal determining the repetition rate of the optically active element is derived from the at least some of the repetitive pulsed radiation .

61. The apparatus of claim 47, wherein the repetition rate of the repetitive pulsed radiation is maintained at fixed value by means of feedback circuitry, a control mechanism and a stable reference.

62. The apparatus of claim 61, wherein the control mechanism is temperature control.

63. The apparatus of claim 47, wherein the optically active element is a pulsed laser diode.

64. The apparatus of claim 47, wherein the optically active element is a gain switched laser diode.

65. The apparatus of claim 64, wherein the gain switched laser diode receives a current pulse from circuitry containing a step recovery diode and an RF source.

66. The apparatus of claim 47, wherein the optically active element is a mode locked laser source.

67. The apparatus of claim 47, wherein the peak power of the pulsed output of the optically active element is increased by compressing the temporal duration of the pulsed radiation.

68. The apparatus of claim 67, wherein the temporal compression of the pulsed radiation is achieved by means of saturable absorption.

69. The apparatus of claim 67, wherein the temporal compression of the pulsed radiation is achieved by means of diffraction gratings.

70. The apparatus of claim 67, wherein the temporal compression of the pulsed radiation is achieved by means of distributed fiber diffraction grating.

71. The apparatus of claim 67, wherein the temporal compression of the pulsed radiation is achieved by means of at least one non linear fiber loop.

72. The apparatus of claim 47, wherein the optically active element is stabilized to emit radiation at a specific wavelength.

73. The apparatus of claim 72, wherein the optically active element is wavelength stabilized by means of seeding by a wavelength stabilized laser.

74. The apparatus of claim 72, wherein the optically active element is wavelength stabilized by means of a reflective Bragg grating.

75. The apparatus of claim 47, wherein the optically active element is coupled to the optical processing element by means of fiber coupling.

76. The apparatus of claim 47, wherein the optically active element is coupled to the optical processing element by means of waveguide elements.

77. The apparatus of claim 47, wherein the optically active element and the optical processing element are coupled interferometrically operable to transfer substantially all the repetitive pulsed pump radiation to the optical processing element and operable to prevent said radiation from emerging from the optical processing element at the coupler.

78. The apparatus of claim 47, wherein the optical processing element and the optically active element are coupled by means of both being positioned between reflective elements, said reflective elements operable to confine predetermined amounts of the repetitive pulsed pump radiation and the repetitive generated pulsed radiation.

79. The apparatus of claim 47, wherein at least one reflective element is a facet of a laser source.

80. The apparatus of claim 47, wherein at least one reflective element is an end of the optical processing medium.

81. The apparatus of claim 47, wherein the reflective elements are distributed Bragg gratings.

82. The apparatus of claim 47, wherein one reflective element is highly reflective at the wavelengths of the generated set and at the wavelength of the laser source.

83. The apparatus of claim 47, wherein at least one of the reflective elements transmits an equal amount of each wavelength in the generated set of wavelengths.

84. The apparatus of claim 47, in which the repetitive pulsed pump radiation coupled into the optical processing medium operable to generate other wavelengths by means of

wave mixing in the non-linear medium.

85. The apparatus of claim 47, wherein at least some of the reflective elements reflect a portion of at least some of the multiplicity of discrete wavelengths operable in a manner that is synchronous with the repetitive pulsed pump radiation

86. The apparatus of claim 47, wherein at least some of the reflective elements reflect a portion of at least some of the multiplicity of discrete wavelengths operable in a manner that seeds the generation of these reflected wavelengths.

87. The apparatus of claim 47, wherein two low power continuous wave laser diode sources are also coupled to the optical processing medium, operable as seeding elements to seed generation of higher power pulsed radiation at the wavelengths of the two low power laser diodes, said higher powered pulsed radiation being powered by the repetitive pulsed pump radiation.

88. (canceled) The apparatus of claim 87, wherein the seeding wavelengths are seeding elements operable to generate additional wavelengths of the multiplicity discrete wavelengths.

89. The apparatus of claim 47, wherein the multiplicity of wavelengths generated correspond to wavelengths on a standard grid.

90. The apparatus of claim 89, wherein the standard grid is an optical communications ITU grid.

91. The apparatus of claim 47, wherein the optical processing element includes waveguide elements.

92. The apparatus of claim 47, wherein the optically active element includes waveguide elements.

93. The apparatus of claim 47, wherein the optical processing element has a fiber coupled output.

94. A means of generating repetitive pulsed radiation with a multiplicity of discrete wavelengths,

comprising:

means for positioning an optical processing medium in a resonant cavity with reflective elements;

and

means for generating repetitive pulsed radiation from a pulsed laser source in a pump cavity with reflective elements;

and

means for coupling the resonant and pump cavities;

and

means for seeding the optical processing medium with at least some of the discrete wavelengths, such that pulsed radiation with a multiplicity of discrete wavelengths is generated.

APPENDIX B

REPLACEMENT SPECIFICATION

APPENDIX C

REPLACEMENT DRAWINGS

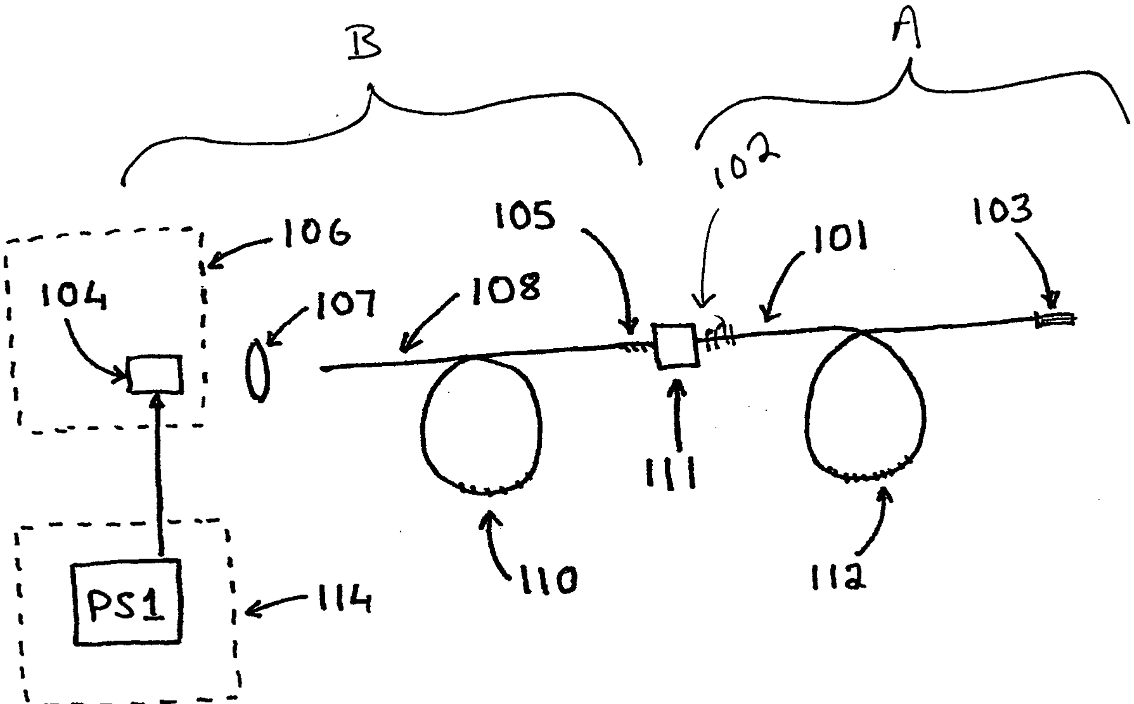

FIGURE 1

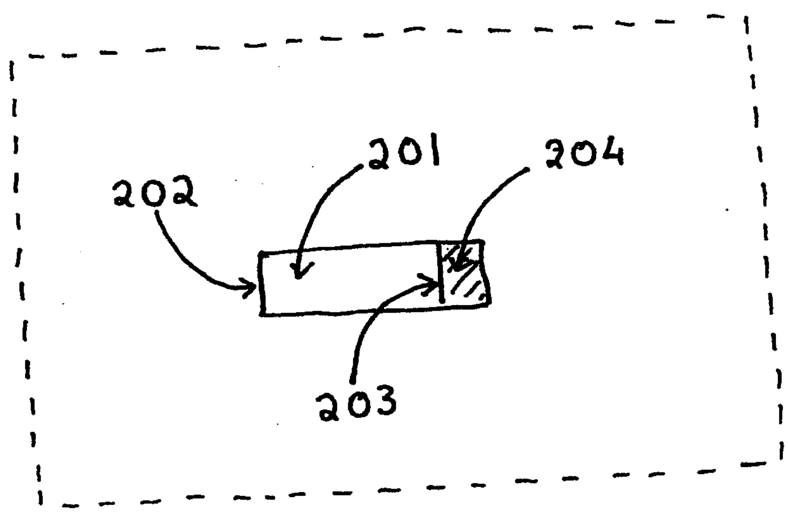

FIGURE 2

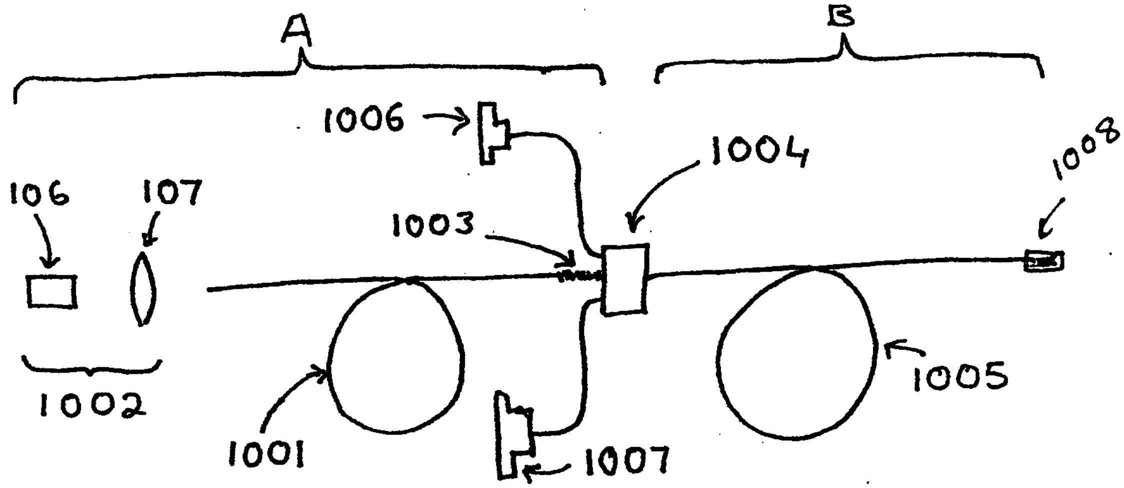

FIGURE 10

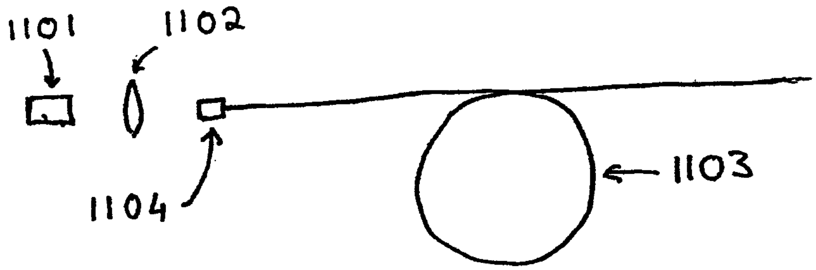

FIGURE 11